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VARIETIES OF PITYROGRAMMA TRIANGULARIS.

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Ever since the publication of Eaton's Ferns of North America, the "California gold and silver ferns" have been treated as a single species with one variety or as two species. This disposition, however, fails to account for all the forms which, as shown by later and much more ample collections than Eaton had before him, exist in this, within certain limits, highly variable group. Instead of two, there are four distinguishable extremes, occupying different ranges, but separated by characters either too slight in themselves or too little constant to warrant their segregation as species. They are, nevertheless, well worth recognition as geographic varieties.

Eaton's description still serves very well for the group as a whole: it may, however, be expanded and amended in some particulars. In addition to the narrow scales of the rootstock, the lower portion of the stipe often bears broader, thinner, pale brown, ovate-lanceolate, acuminate scales which may or may not have a narrow, blackish, sclerotic median band. The stipes vary from bright red-brown to blackish in color. In all varieties the pinnae vary considerably in shape and cutting. The large lower pinnae do not always have the basal segments on the lower side elongated; sometimes, even in well-developed fronds, they are no longer than the others. When greatly developed, they are usually narrowed toward the base. The basal segments of the upper side sometimes equal the others, sometimes are shorter. The lower basal segments of the second pair of pinnae are sometimes elongated like those of the first pair, sometimes

shorter than the others. In one variety, the spores are trilobate in outline; in all, they are vernicose-reticulate with low, flat-topped ridges.

The farinose indument of the lower surface of the lamina is secreted by minute glands, well described and figured by Blasdale, Erythrea, i. 253, pl. 2. When they occur on the leaf-surface, these glands are borne on short unicellular stalks, as figured by him: when, however, they grow along the veins, among the sporangia, the stalks lengthen, becoming two or three cells long and raising the secreting terminal cells above the sporangia. In addition, many specimens of *P. triangularis* bear on the under surface of the lamina long-stalked glands with shining, wine-colored, pyriform heads nearly twice as large as those of the indument-secreting glands. What their function may be is not apparent. When glands occur on the upper surface, they are similar in size and structure to the secreting glands of the lower surface. They produce either a somewhat farinose or an apparently gummy substance, but only in small quantities.

Occasionally, as noted by D. C. Eaton, Contr. Nat. Herb. iv. 227, the glands of the lower surface fail to function (perhaps, as he suggested, because of an excess of moisture or shade), producing little or none of the usual farinose indument. They then appear as distinct but numerous, yellow dots and these, seen against the green of the leaf-tissue, probably give the appearance which has led to such specimens being distributed as "bronze-powdered forms." A merely glandular appearance of the lower surface must, however, be taken with some caution in the case of old herbarium specimens which may have been poisoned with corrosive sublimate. The alcohol in this compound, if applied in sufficient quantity, entirely removes the soluble indument. A good example of its effect is seen in the National Herbarium specimen of Palmer's no. 856 in 1889 from Guadelupe Island, Lower California. In this plant, the under surface appears merely glandular except for the tips of the pinnae which escaped the corrosive sublimate bath or brush and are thickly covered with white indument. With a little practice, one learns to distinguish poisoned specimens by a certain drenched and matted appearance under a lens.

Maxon, Contr. Nat. Herb. xvii. 173 (1913), has shown that the correct generic name for the group here considered is Pityrogramma Link, Handb. Gewachs. iii. 19 (1833).

The descriptive key which follows will serve to indicate the distinguishing characters of the three varieties here recognized. They include nearly all the plants which have hitherto passed as white-powdered forms of *P. triangularis*. True *P. triangularis* with white indument appears to be rare, as one would expect in the case of an albino form. Except as noted under var. *viscosa*, the size and cutting of the lamina covers an essentially similar range of variation in all the varieties, though with more or less marked tendencies toward a certain type in each and a consequent difference of aspect much more easily seen than described.

I have had the privilege of examining in addition to the specimens in the Gray Herbarium, the material in the United States National Herbarium, the herbaria of Yale and Leland Stanford Universities and the Philadelphia Academy of Natural Sciences.[1] For this valuable opportunity I am indebted to the authorities of these institutions. I am also under special obligation to Rev. George L. Moxley for procuring for me living plants of var. *viscosa*, to Mr. Bayard Long for needed information on various matters and to Mr. William R. Maxon for encouragement and helpful criticism throughout. I take pleasure in dedicating one of the segregates here described as new to Mr. Maxon, as some small evidence, if it may pass as such, partly of personal gratitude for many courtesies received, but still more of the appreciation of his admirable work which all fern-students must feel.

A. Upper surface of the usually coriaceous lamina *glabrous;* stipe usually bright red-brown and shining in young fronds, turning darker with age, essentially glabrous; indument bright to pale *yellow*, rarely white or lacking; basal segments of the lowest pinnae usually elongate and pinnatifid; spores round to deltoid in outline.....1. *P. triangularis*

A. Upper surface of the lamina *glandular* or *viscid* or both; indument *white*, rarely pale yellow or lacking

B. Upper surface of the usually coriaceous lamina *viscid*, often also with yellowish, stalked, resinous glands; stipe red-brown, essentially glabrous; lower basal segments of the lowest pinnae usually only undulate-crenate, not pinnatifid; spores round to deltoid in outline; plant of southwestern California.....var. *viscosa*

B. Upper surface of the often rather thin lamina *glandular* only, not viscid; lower basal segments of the lowest pinnae usually elongate, dilated and deeply pinnatifid.

C. Stipes mostly *blackish* and *glandular* and *white-farinose* above and near the base, not very lustrous; lamina thin and soft, usually

[1] Indicated in the citation of specimens by the following symbols: Gray Herb., G; U. S. National Herb., N; Herb. Phil Acad., P; Herb. Stanford Univ., S; Herb, Yale Univ., Y.

thickly beset above with whitish glands, giving it a gray appearance; spores *round* to *deltoid* in outline; plant of the mountain regions of central California.....var. *pallida*

C. Stipes mostly *red-brown* and essentially *glabrous;* lamina subcoriaceous, beset above with usually rather sparse yellowish glands; spores *trilobate* in outline; plant chiefly of Arizona, southeastern California and adjacent portions of Mexico .....var. *Maxoni*

PITYROGRAMMA TRIANGULARIS (Kaulf.) Maxon Contr. Nat. Herb. xvii. 173 (1913). *Gymnogramma triangulare* Kaulf. Enum. Fil. 73 (1824); Brack. U. S. Expl. Exp. xvi. Bot. Fil. 23 (1854). *Gymnogramme triangularis* Hook. & Grev. Ic. Fil. ii. t. 153 (1831); Hook. Fil. Exot. t. 10 (1859); Hook. Sp. Fil. v. 146 (1864); Hook. & Bak. Syn. Fil. 384 (1868); D. C. Eaton, Ferns of the Southwest 304 (1878), Ferns of N. Am. ii. 15 t. 48, figs. 1–5 (1879) and in Watson Bot. Calif. ii. 335 (1880); Meehan, Fl. and Ferns of the U. S., ser. 2, i. 177, t. 44 (1880). *Gymnogramma triangularis* Hook. & Arn. Bot. Beechey Voy. 161 (1833); Hook. Fl. Bor. Am. ii. 259 (1840); Torrey, Pac. R. R. Rep. iv. 160 (1856). *Gymnogramme oregana* Nutt. in D. C. Eaton, Ferns of the Southwest 305 (1878) and Ferns of N. Am. ii. 16 (1879), as syn. *Gymnopteris triangularis* Underw. Our Nat. Fern ed. 6, 84 (1900). *Ceropteris triangularis* Underw. Bull. Torr. Bot. Club xxix. 630 (1902); Christensen, Ind. Fil. 170 (1905).

In the case of a plant so well known as is the typical form of *P. triangularis*, it seems hardly worth while to cite the very numerous specimens examined. As to range, specimens have been seen from Clark Co., Nevada; San Diego, Riverside, San Bernardino, Los Angeles, Santa Barbara, Kern, San Luis Obispo, Inyo, Monterey, Santa Cruz, Santa Clara, Mariposa, Alameda, Tuolumne, Calaveras, Amador, Marin, Sonoma, Yuba, Butte, Mendocino, Plumas, Tehama and Humboldt Counties, California; Coos, Douglas, Lane, Linn, Marion and Multnomah Counties, Oregon; Klickitat, Pierce, Clallam and Island Counties, Washington; Vancouver Island, B. C.: and the northern part of Lower California. In specimens from Spring Valley, San Diego Co., Cal., (Feb.–May, 1900, *Laura F. Kimball*, N) and from Panamint Mts., Inyo Co., Cal. (*Coville & Funston*, 610, N) the lamina is merely glandular beneath with no evidence of poisoning. *Leiberg* 3508 from near Sinartville, Yuba Co. (N), and part of the material under Mrs. R. M. Austin's no. 977 from Quincy, Plumas Co. (N) represent white-powdered forms.

All but one of the specimens seen from north of California, most of those from the northern and more inland portions and some from the southern part of that state, have the red glands mentioned above.

Those from the coastal region from Sonoma County south to Santa Barbara County, on the contrary, show no trace of these glands and average somewhat larger in size. This difference, however, correlates with no other character and seems to call for no taxonomic recognition. Chamisso's type collection of *P. triangularis* was made at San Francisco Bay and doubtless belongs to the glandless form. The original material of *Gymnogramme oregana* Nutt., preserved at the Philadelphia Academy, consists of two plants, one well-developed, with stout stipes 2–5 dm. long, the other small, with slender stipes 1–2 dm. long, and of two detached fronds. In all, the fronds are very young, the lamina hardly fully expanded, and have a whitish indument. They show the red glands which seem to be characteristic of the northern material of *P. triangularis*. Nuttall himself has, on his label, crossed out the name *oregana* and written in *triangularis* with a reference to Hooker and Greville's plate of that species.

Var. **viscosa** (Nutt. ex. D. C. Eaton), n. comb. *Gymnogramme triangularis*, var *viscosa* D. C. Eaton, Ferns of N. Am. ii. 16 (1879) and in Watson Bot. Cal. ii 335 (1880). *Gymnogramme viscosa* Nutt. in D. C. Eaton, Ferns of the Southwest 305, (1878) as syn. and Ferns of N. Am. l. c. *Gymnogramme pyramidalis* Nutt. in D. C. Eaton, l. c., as syn. *Ceropteris viscosa* Underw. Bull. Torr. Bot. Club xxix. 631 (1902); Christensen, Ind. Fil. 170 (1905). *Pityrogramma viscosa* Maxon, Contr. Nat. Herb. xvii. 173 (1913).

California. San Diego County: Mission Hills, May 5, 1903, *LeRoy Abrams*, 3396 (G, S: glandular above; basal segments pinnatifid); shady ledges, Howard Cañon, La Jolla, Apr. 14, 1914, *F. E. & E. S. Clements*, 2 (G: indument yellowish); Rancho de la Nacion, *Kimball* (G); sides of ravines, Del Mar, March, 1894, *Canby* (G: glandular above; mixed with *P. triangularis*); dry hillsides, Linda Vista, July 6, 1915, *Macbride & Payson*, 788 (G); Jamul Valley, 1875, *Palmer*, 433 (G: glandular above); Eucalyptus Cañon, *hb. M. Rodman* (G); moist ravine, 15 miles north of San Diego, March 7, 1862, *J. G. Cooper*, 439 (N: glandular above); Otay Mesa, May 14, 1915, *Collins & Kempton*, 79 (N); San Miguel Mts., Feb.–May, 1900, *Kimball* (N: glandular above); San Diego, March 14, 1882, *M. E. Jones*, 3067 (N); Apr., 1875, *hb. G. C. Woolson* (Y); *D. Cleveland* (Y); Pala, June 1880, *Parish* (Y); Evendido, Apr. 11, 1914, *Parish*, 9092 (S); Coast Mts., June, 1897, *Parish* (S: mixed with *P. triangularis*); Old Mission Dam, alt. 350 ft., Apr. 10, 1904, *H. P. Chandler*, 5055 (S: glandular above); San Diego, *Nuttall* (P: types of *Gymnogramme viscosa* and *G. pyramidalis*). Riverside County: Pigeon Pass Road, near summit of Box Springs Mt., alt. 1800 ft., Feb. 27, 1910, *Reed*, 2947 (N). Los Angeles County: Santa

Catalina Isl., "common in canons" Avalon, June 2, 1895, *Trask* (N); dry hillsides, March 29, 1900, *Grant*, 122 (S); Apr. 21–24, 1904 (S); 1885, *W. S. Lyon* (G).

Nuttall's material of *Gymnogramme viscosa* in the Herbarium of the Philadelphia Academy consists of two small detached fronds about 5 cm. long, with the characteristic habit of extreme var. *viscosa* and without glands on the viscid upper surface of the lamina. The specimen of *G. pyramidalis* is a single large frond, 10 cm. long, again with the characteristic *viscosa* habit and with stalked glands plainly apparent on what little of the upper surface shows. Underwood's statement, l. c. 630, that one of Nuttall's Oregon specimens was labelled by him "*viscosa" indicates an error somewhere. Var. *viscosa* is a very local plant, known only from southwestern California.

Var. *viscosa* varies considerably in leaf-form. The extreme and most characteristic form figured by Eaton has rather distant pinnae and comparatively few, likewise distant, segments. But both pinnae and segments may be as close and the latter as numerous as in the typical form of the species, thus constituting a transition to it, so far as these characters are concerned. The most remarkable variation in this direction is found in specimens collected at San Diego by D. Cleveland (Y) and at San Miguel Mt., near National City by Miss Laura F. Kimball in 1900 (N). These have very large fronds (14 cm. long) with viscid upper surface and white indument, but tripinnatifid, with numerous segments and the lower basal pinnules very large and deeply pinnatifid. Their appearance is altogether that of luxuriant states of typical *P. triangularis*. Specimens collected by Blanche Trask at Avalon, Santa Catalina Island (N) have the characteristic habit of var. *viscosa*, but the upper surface of the lamina glabrous, and in this respect are transitional to the typical form. The fronds in these specimens are young; but in all other specimens of var. *viscosa* seen, the fronds even when very young are strongly viscid. Collins & Kempton 88 from the Otay Mesa, San Diego, May 14, 1915 (N) has the thick frond and general habit of var. *viscosa*, but the upper surface of the lamina is densely glandular and not at all viscid and the spores are somewhat trilobate. In these respects, it is transitional to var. *Maxoni*. In some specimens, every distinctive character of var. *viscosa* breaks down in

the direction of one or another of the other varieties; Underwood's raising of it to specific rank seems not to have been justified.

Var. **pallida**, n. var. Stipitibus nigrescentibus superne basinque versus plerumque minute glandulosis et albo-farinosis; laminis tenuibus, supra propter glandulas albidas opacas subfarinosas plerumque numerosas pallidis, subtus albo-farinosis; pinnarum infimarum segmentis vel pinnulis basiscopis elongatis dilatatis profunde pinnatifidis; sporis circumscriptione rotundis vel deltoideis angulis obtusissimis.

California: Santa Clara County: *Mrs. Bush* (G). Tulare County: Kaneah, Apr. 28, 1895, *Eastwood* (G). Madera County: Hills about three miles above Pollasky, Apr. 11, 1906, *Heller*, 8141 (type in Hb. Gray; also N, S). Amador County; White Bar, alt. 1000 ft., May 13, 1896, *Hansen*, 1637 (N). Eldorado County: rocky bluffs along Camp Creek. 8 miles north of Grizzly Flats, June 1, 1902, *W. G. Watkins*, 16 (N). Butte County: Iron Cañon, 1870, May, 1883, May, 1896, 197, May, 1897, *Mrs. Austin* (all N). Without definite locality: 1879, *Miss E. D. Pelton* (Y).

Heller's comment on the type collection describes very well the obvious external characters of this variety which he supposed to be *viscosa*. "When fresh," he says, "the upper side of the frond is much paler than is that of the other species [*triangularis*] and the whole plant less stiff." The specimen of the type number in the Herbarium of the Philadelphia Academy has the stipe more nearly glabrous than usual and the white indument scanty or lacking.

So far as the material at hand shows, var. *pallida* holds its characters better than any of the other varieties. These characters, however, are rather slight and comparative, and in the region where both occur, *P. triangularis* exhibits some tendency to develop white-powdered forms which suggest a transition to var. *pallida*. Everything considered, I am unable to regard the latter as more than a well-marked variety.

Var. **Maxoni**, n. var. Stipitibus rubro-brunneis nitidis glabris, laminis subcoriaceis vel tenuibus supra plerumque sparse glandulosis, glandulis flavescentibus juventute nitidis aetate opacis; pinnarum infimarum segmentis vel pinnulis basiscopis plerumque elongatis et profunde pinnatifidis; sporis circumscriptione trilobatis, lobis rotundatis.

Arizona: Santa Catalina Mts., Apr. 23, 1881, *Pringle* (G); shaded pass, rocky cañons of the Santa Catalina Mts., May 23, 1881, *Pringle* (N); under rock shelf near falling water, head of Rincon Valley, Rincon Mts., alt. 3500 ft., July 27, 1909, *J. C. Blumer*, 3271

(TYPE in Nat. Herb.; G, S,); Salt River, 16 miles north of McMillinville, alt. 2800 ft., May 24, 1916, *E. A. Goldman*, 2672 (N).

CALIFORNIA. SAN DIEGO COUNTY: Jacumba Hot Springs, May 23, 1894, *E. A. Mearns* (International Boundary Commission, 3320 (N); desert slopes of San Jacinto Mts., Apr., 1882, *Parish*, 501a. RIVERSIDE COUNTY: Whitewater, Feb., 1881, *Vasey* (N); under rocks in Palm Cañon, May 19, 1917, *Reed*, 3871 in pt. (N). SAN BERNARDINO COUNTY: Mentone, 1904, *R. J. Smith*, 25 (G); Palm Springs, Apr. 30, 1913, *Eastwood*, 3018 (N); Andreas and Murray Cañons, Palm Springs, Aug. 23, 1906, *T. H. Kearney* (N). SANTA CLARA COUNTY: Coast Range, Dec. 28, 1878, *L. G. Yates* (S: mixed with *P. triangularis* and possibly not actually from this locality). WITHOUT DEFINITE LOCALITY: 1876, *Parry & Lemmon*, 431 (G); desert district between California and Arizona, 1876, *Parry* (G).

LOWER CALIFORNIA: Sierra de Laguna, Jan. 23, 1897, *Brandegee* (N); Cedros Isl., *Brandegee* (N).

SONORA: damp cool shade, Huchuerachi, Dec. 12, 1890, *F. E. Lloyd*, Lumholtz Exp., 484 (G).

The large suite of specimens in the National Herbarium shows every gradation from the round spores of typical *P. triangularis*, through blunt-angled deltoid shapes, to the strongly trilobate spores of var. *Maxoni*. Palmer's no. 856 in 1889 from Guadelupe Island, Lower California (N), and his no. 101 in 1875 from the same place (G, Y) have the glabrous upper surface and general habit of typical *P. triangularis*, but white indument and some of the spores more or less trilobate. Specimens collected at Nine Mile Cañon, Ariz., by J. H. Ferriss (P) have the habit, in different fronds, of both var. *Maxoni* and the typical form, the glandular surface of the former and the yellow indument and round spores of the latter. No. 1589 of the Mexican Boundary Commission (Emory Expedition; N) has a glandular upper surface and round spores. R. H. Alderson's no. 754 from Witch Creek, San Diego Co., California, has the frond finely cut and the upper surface slightly glandular but yellow indument. All of them are in one way or another transitional to the typical form. It may be added that transitional specimens usually do not show exceptional vegetative vigor (the Cleveland and Kimball collections mentioned above are exceptions; more often just the contrary is the case), shrivelled spores or any other of the usual indications of hybridity.

GRAY HERBARIUM.